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| APPLICATION NO | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO | CONFIRMATION NO |
|----------------|-------------|----------------------|--------------------|-----------------|
| 09 686,624 | 10/12/2000 | Jung-Ho Lee | 10,253,006 | 6123 |

27849 7390 05/21/2003
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[REDACTED] EXAMINER

NGUYEN, KHIEM D

[REDACTED] ART UNIT [REDACTED] PAPER NUMBER

2823

DATE MAILED: 05/21/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | |
|------------------------------|-----------------|------------------|
| Office Action Summary | Application No. | Applicant(s) |
| | 09/686,624 | LEE ET AL. |
| Examiner Khiem D Nguyen | Examiner | Art Unit 2823 |
| | | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 04 February 2003.
- 2a) This action is FINAL. 2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 10-12 and 14-28 is/are pending in the application.
 - 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) Claim(s) 23-28 is/are allowed.
- 6) Claim(s) 10-12 and 14-22 is/are rejected.
- 7) Claim(s) _____ is/are objected to.
- 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on 12 October 2000 is/are: a) accepted or b) objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) The proposed drawing correction filed on _____ is: a) approved b) disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.
- 12) The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.
- 14) Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
 - a) The translation of the foreign language provisional application has been received.
- 15) Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) Notice of References Cited (PTO-892)
- 2) Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) Information Disclosure Statement(s) (PTO-1449) Paper No(s) 10
- 4) Interview Summary (PTO-413) Paper No(s) _____
- 5) Notice of Informal Patent Application (PTO-152)
- 6) Other

DETAILED ACTION***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 10-12 and 14-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over the applicant's admitted prior art (AAPA) of this application in view of Imamura et al. (U.S. Patent 5,738,911), Shibuya et al. (U.S. Patent 6,338,868), Tanaka et al. (U.S. Patent 5,974,666) and Kajiura et al. (U.S. Patent 5,907,382).

AAPA teaches a method of forming a silicon oxide layer comprising (see Description of the Related Art on pages 1-3 of this application):

providing a semiconductor substrate having a stepped portion formed by at least two conductive patterns selected from gate electrodes and metal wiring patterns of a semiconductor device;

coating the semiconductor substrate with a spin-on glass (SOG) composition; curing the SOG layer to form a layer of silicon oxide having a planar surface.

AAPA fails to teach that the spin-on glass (SOG) composition containing perhydropolysilazane having the compound formula -(SiH₂NH)_n- wherein n represents a positive integer, and main-baking the SOG layer at a temperature within the range of about 400 to about 1,200°C for a second period of time wherein the main-baking is conducted under an atmosphere comprising one ore more components selected from the

group consisting of oxygen, water vapor, mixtures of oxygen and water vapor, nitrogen, and mixture thereof, for about 10 to about 180 minutes as recited in present claims 10-12, 22.

Imamura teaches that the silicon oxide layer (SiO_2) is forming by baking a spin-on glass (SOG) composition containing perhydropolysilazane having the compound formula $-(\text{SiH}_2\text{NH})_n-$ (n represents a positive integer) in an air atmosphere consisting of oxygen. Wherein the baking of the perhydropolysilazane is conducted by heating at a temperature ranging from 250° C to 500° C for a time ranging from 0.5 to 3 hours. (col. 3, lines 5-34). It would have been obvious to one of ordinary skill in the art to incorporate Imamura's teaching into AAPA's method because in doing so a uniform thin film having a thickness of several angstroms can be obtained (col. 3, lines 28-30).

Imamura fails to teach that a weight average molecular weight within the range of about 4,000 to about 8,000, and wherein curing the SOG layer comprises pre-baking the SOG layer at a temperature within the range of about 100 to about 500°C for a first period of time as recited in present claims 10-11.

Tanaka teaches that perhydropolysilazane is heated at 150° C for a period of time under an oxygen atmosphere to produce silicon oxide layer wherein perhydropolysilazane having a weight-averaged molecular weight of 4,000 to 5000 (col. 6, lines 51-63 and col. 12, lines 16-24). It would have been obvious to one of ordinary skill in the art to incorporate Tanaka's teaching into Imamura's method because doing so can prevent occurrence of leaking based on uneven electric resistance of an electrically conductive elastic body layer (col. 2, lines 54-61).

Imamura fails to teach that the molecular weight dispersion is within the range of about 3.0 to about 4.0 as recited in present claim 10.

Shibuya teaches coating the surface of a substrate with a spin-on glass (SOG) composition containing polysilazane compound having the molecular weight dispersion not exceeding 4. See col. 3, line 50 to col. 4, line 8. It would have been obvious to one of ordinary skill in the art to incorporate Shibuya's teaching into Imamura's method because in doing so a coating film having high resistance against formation of cracks to serve as a planarizing layer on the surface of a substrate can be obtained (col. 1, lines 8-16).

Neither AAPA, Imamura, Shibuya, Tanaka teach a viscosity range of about 1 to about 10 mPa.s as recited in present claim 10.

Kajiura teaches that the viscosity of the perhydropolysilazane is in the range from 1×10^{-3} to 1×10^{-2} pa.s (col. 13, lines 9-15). It would have been obvious to one of ordinary skill in the art to incorporate Kajiura's teaching into AAPA's method because in doing so a transparent conductive substrate, that has excellent heat resistant characteristic, shock resisting characteristic, chemical resisting characteristic, oxygen barrier characteristic, steam barrier characteristic, and scratch resisting characteristic can be obtained (Abstract).

None of the prior arts teaches the ranges for the thickness of the silicon oxide and silicon nitride layer, the shear rate, the distance between the at least two conductive patterns, the aspect ratio of the stepped portion, and the contact angle as recited in present claims 10, 14, 16-18, and 20-21.

However, it would have been obvious to one of ordinary skill in the art of making semiconductor devices to determine the workable or optimal ranges for the thickness of the silicon oxide and silicon nitride layer, the distance between the at least two conductive patterns, the aspect ratio of the stepped portion, and the contact angle through routine experimentation and optimization to obtain optimal or desired device performance because the ranges for the thickness of the silicon oxide and silicon nitride layer, the distance between the at least two conductive patterns, the aspect ratio of the stepped portion, and the contact angle are result-effective variables and there is no evidence indicating that the ranges for the thickness of the silicon oxide and silicon nitride layer, the distance between the at least two conductive patterns, the aspect ratio of the stepped portion, and the contact angle are critical and it has been held that it is not inventive to discover the optimum or workable range of a result-effective variable within given prior art conditions by routine experimentation. See MPEP 2144.05.

Allowable Subject Matter

Claims 23-28 are allowed.

The following is an examiner's statement of reasons for allowance: The prior art taken alone or in combination neither discloses nor makes obvious the instant process of claims as a whole. Specifically, the prior art fails to teach or disclose wherein curing the SOG layer by pre-baking the SOG layer at a temperature within the range of from about 100 to about 500 °C for a first period of time and main-baking the SOG layer at a temperature for a second period of time as recited in present independent claims 23, 25, and 27.

Response to Amendment

Response to Applicant's Arguments

Applicant's arguments filed 02-04-2003 have been fully considered but they are not persuasive.

In response to Applicant's argument that the Imamura et al. reference and the Tanaka et al. reference belong to an entirely different technical field than the present invention as claimed and therefore constitute non-analogous prior art, Imamura discloses that the silicon oxide layer (SiO_2) is forming by baking a spin-on glass (SOG) composition containing perhydropolysilazane having the compound formula $-(\text{SiH}_2\text{NH})_n-$ (n represents a positive integer) in an air atmosphere consisting of oxygen wherein the baking of the perhydropolysilazane is conducted by heating at a temperature ranging from 250° C to 500° C for a time ranging from 0.5 to 3 hours (col. 3, lines 5-34) and Tanaka discloses that perhydropolysilazane is heated at 150 °C for a period of time under an oxygen atmosphere to produced silicon oxide layer wherein perhydropolysilazane having a weight-averaged molecular weight of 4,000 to 5000 (col. 6, lines 51-63 and col. 12, lines 16-24). The disclose processes as stated would obtain the recited results because the same materials are treated in the same manner as in the instant invention.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within

TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Khiem D Nguyen whose telephone number is (703) 306-0210. The examiner can normally be reached on Monday-Friday (8:00 AM - 5:00 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Chaudhuri Olik can be reached on (703) 306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 746-9179 for regular communications and (703) 746-9179 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.



K.N.
May 15, 2003